



HAL
open science

Environmental Hazard Prevention: Monitoring and Control of Landslide Risks in Mountainous Forests

Polina Lemenkova

► **To cite this version:**

Polina Lemenkova. Environmental Hazard Prevention: Monitoring and Control of Landslide Risks in Mountainous Forests. Actual Problems in the Development of Forestry, Vologda State University, Dec 2015, Vologda, Russia. pp.20-21, 10.6084/m9.figshare.7210376 . hal-01973514

HAL Id: hal-01973514

<https://hal.science/hal-01973514>

Submitted on 11 Jan 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons CC0 - Public Domain Dedication 4.0 International License

ENVIRONMENTAL HAZARD PREVENTION: MONITORING AND CONTROL OF LANDSLIDE RISKS IN MOUNTAINOUS FORESTS

P. A. Lemenkova

Czech Republic, Přírodovědecká fakulta Univerzita Karlova v Praze, Prague

This paper analyses optimal methods for the estimation of the environmental hazards with a case study of landslides causing degradation of the mountainous forest ecosystems. The aim of this work is analysis of possible methods of estimating consequences caused by environmental hazards affecting forest ecosystems. Methodological advances have been made in regional applications of landslides risk studies, including specific research questions, such as vulnerability estimation [11],[9], [10], [14], [17], economic estimation of the losses, assessment of risk perception and social aspects of risk [13], cartographic aspects of risk mapping [9], [1], [16], as well as elaboration of the methodology of the overall risk assessment [14].

The GIS-based mapping is undoubtedly indispensable tool for landslide risk studies, applicable both for spatial and temporal aspect of the hazard risk assessment. Many successful examples of landslide risk assessment and susceptibility analysis based on GIS mapping were done [3], [11], as well as calculation of the Normalized Difference Vegetation Index [6]. Various example of the thematic mapping of forest ecosystems are provided. For all that, the applications of the risk studies specifically for the mountainous forest landscapes mostly depend on hazard occurrence and data availability, accessibility, compatibility and integration. Usually, scientific reports focus on mountainous Alpine regions, which are well studied [15], [12].

The studies of risk assessment of natural hazards grew from the engineering branch of risk analysis and are being now rapidly developed since 1990s. The understanding of the concept “risk” varies at different authors, with the main difference in the degree of objectivity of risk concept: some authors define risk as independent and ‘given’ value, while others stress the influence of social factor on overall risk. According to the UNISDR, risk is a “probability of harmful consequences, or expected losses (deaths, injures, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions”. When applying this general concept to the natural context, risk is defined [12] as a product of hazard and vulnerability of the elements disposed to risk. Risk assessment is mainly focusing on risk management of natural hazards, i.e. with a main stress on human-environmental co-operation and co-existence [8]. Management of risk aims to lessen the risk levels, and includes estimation of risk and actions to minimize overall risk level. The evaluation includes identification of main stakeholders and elements at risk, monetary values of losses, strengths, weaknesses of the elements at risk, significant factors in the environment, outcomes expected, established risk criteria [4]. Risk identification involves examining all sources of risk from the perspective of all stakeholders.

There are different methods of qualitative and quantitative assessment of landslide risk, including risk analysis, which aims at the identification of hazard consequences and defining possible endangered regions. The level of risk is the combination of the likelihood of a risk occurring and the consequences if it does occur. In the risk estimation there are proposed levels of risk identified for landslide hazards [14]: intolerable, tolerable and acceptable. The results of risk analysis and assessment can considerably lessen potential consequences of landslide hazards. The landslide hazard is expressed as a limited probability that a landslide occurs within a given period of time [7]. There are proposed method of the recurrent intervals for the definition of the landslide hazard zones. Methods of predicting dynamic movements of the landslides and estimating their temporal probability are not well elaborated yet and are hardly available. The assessment of temporal probability of landslides is very difficult to perform. The risk of landslide processes is strongly determined by the wide variety of different factors, among which is the slope angle. Other factors, associated with landslides, are geological structure, material characteristics, water pressure, topography, river erosion, and weathering. These are also important triggers in landslide formation and movements [5]. All objects that can be affected by the landslides are usually defined as elements at risk: it can be humans and valuable objects located in the endangered area. It is assumed that elements at risk include buildings, infrastructure, services, property, population and environment. The population at risk is defined as a number of people present in dangerous areas, whose losses are expressed as health injury and deaths. The risk for population is estimated as possible losses of lives. Valuable objects can be more easi-

ly assessed, based on their absolute monetary value and costs of assurance [2]. Thus, values of buildings, infrastructures and services are determined from the real estate agencies or owners. Property at risk includes number of houses, businesses and retailers, machinery, domestic animals and personal belongings.

The sustainable functioning of unique and sensitive forest ecosystems is highly adjusted towards climatic-environmental settings. The proper risk assessment of possible hazards should be included into the monitoring program for better understanding of ecosystem functioning and avoiding deforestation. Current paper contributed towards risk assessment studies by systematization of the existing methodology recommended for the environmental hazard assessment.

Literature

1. Barbolini M., Pagliardi M., Ferro F., Corradeghini P. (2011), Avalanche hazard mapping over large undocumented areas, *Natural Hazards*, 56, 451–464.
2. Bohle H.-G., Glade T. (2008), Vulnerabilitätskonzepte in Sozial- und Naturwissenschaften. In: *Naturrisiken und Sozialkatastrophen*, Felgentreff C., Glade T. (Eds.), Spektrum Akademischer Verlag, Springer-Verlag Berlin, 99-121.
3. Brabb E.E., (1984). Innovative approaches to landslide hazard and risk mapping. *Proceedings of 4th International Symposium on Landslides*, Canadian Geotechnical Society, Toronto, 1, 307-323.
4. Buchanan M., Porter, N., (1999), *Guidelines for Managing Risk in the Australian and New Zealand public sector*. Standards Association of Australia, Strathfield, NSW, Australia.
5. Crozier M., (1986) Field assessment of slope instability. In: *Slope instability*. Eds Crozier M & Prior DB John Wiley & Sons, 103-142.
6. Crippen, R.E., (1990). Calculating the vegetation index faster. *Remote Sensing of Environment*, 34, 71-73.
7. Einstein H.H., (1997), *Landslide Risk – Systematic Approaches to Assessment and Management*. In: Cruden DM and Fell R (eds) *Landslide Risk Assessment*. Proceedings of the international workshop on landslide risk assessment / Honolulu / Hawaii / USA / 19-21 February 1997. Balkema, Rotterdam, 25–50
8. Elverfeldt K., Glade T., Dikau R., (2008), *Naturwissenschaftliche Gefahren- und Risikoanalyse*. In: Felgentreff C., Glade T. (eds). *Naturrisiken und Sozialkatastrophen*. Springer-Verlag Berlin Heidelberg. 31-47.
9. Fuchs S, Spachinger K, Dorner W, Rochman J, Serrhini K. (2009) Evaluating cartographic design in flood risk mapping. *Environmental Hazards* 8 (1), 52-70.
10. Fuchs S., Holub M., (2010), Vulnerability to mountain hazards – fundamentals with respect to an optimal safety of structures. In: E. Ardillon (ed.). *Structural reliability analyses into system risk assessment*. Høvik, DNV, 120-137.
11. Glade T., Amderon M., Crozier M., (2005), *Landslide Hazard and Risk*. John Wiley & Sons.
12. Glade T., Dikau R. (2001) Gravitative Massenbewegungen: vom Naturereignis zur Naturkatastrophe. *Petermanns geographische Mitteilungen*. 145 (6), 42-53.
13. Kozak M., Crotts J., Law R., (2007), The Impact of the Perception of Risk on International Travellers. *International Journal of Tourism Research* 9, 233–242.
14. McKendrick J.D., (1987), Plant Succession on Distributed Sites, North Slope, Alaska, U.S.A. *Arctic and Alpine Research*, 19 (4), 554-565.
15. Moser M., (1999), Großhangbewegungen im alpinen Raum. Verbreitung – Kinematik: Klimatische Einflüsse, Klassifikation. In: Fischer K.: *Massenbewegungen und Massentransporte in den Alpen als Gefahrenpotential*, 14, 97-116.
16. Remondo J, Bonachea J, Cendrero A. (2008). Quantitative landslide risk assessment and mapping on the basis of recent occurrences. *Geomorphology* 94, 496–507.
17. Siegel P.B., Jorgensen S.L. (2001). *Vulnerability: A view from different disciplines*. Social Protection Discussion Paper Series. Human Development Network. The World Bank. New York.